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# NOTES ON THE HYBRIDS BETWEEN THE CANARY AND TWO AMERICAN FINCHES

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PERHAPS no animal has been so often crossed with other species, and even genera, as the domesticated canary (*Serinus canarius*). Darwin (1885, I, p. 311) speaks of "nine or ten" such crosses, but many more have undoubtedly been made. The hybrids resulting from these crosses are usually, if not always, infertile, and hence are popularly known as "mules." In almost all of these crosses the domesticated canary serves as the female and the wild finch as the male, but bird fanciers occasionally succeed in making the reverse cross. The wild species which is most commonly used for this "mule breeding" is the European goldfinch, *Carduelis carduelis* Linnæus.<sup>1</sup>

This fringillid is one of the handsomest finches in existence, the plumage of the adults of both sexes being made up of a beautiful combination of black, red, white, yellow, and brown patches. The hybrids which result when a yellow, or nearly yellow, canary is crossed with this finch are chiefly interesting for two reasons: (1) because they exhibit an apparently endless chain of variability in coloration, and (2) because their plumage, if dark, is conspicuously streaked, a character which is lacking (as far as external appearance is concerned) in both the yellow canary and the European goldfinch.

Concerning the first of these two points valuable data have been published by Bechstein (1795), Hünefeld (1864), Blakston (1880?), Klatt (1901), Davenport

<sup>1</sup> According to Chapman (1916, p. 383), this finch was introduced into the United States at Hoboken, N. J. (in 1878), and Boston, and probably still is a resident near both of these places.

(1908), and Galloway (1909). According to these authors, the hybrids between the yellow canary and the European goldfinch may be: (a) completely dark, (b) mottled (spotted), exhibiting an apparently endless variation in color pattern, or (c) entirely white or yellow (very rarely).<sup>2</sup>

The streaking in the dark plumage of canary-European goldfinch hybrids has been variously explained as: (a) "derived from the original wild canary" (Darwin, 1885, II, p. 15); (b) as reversion to the Serin finch, *Serinus hortulanus* Koch (Klatt, 1901, p. 508); and (c) as resulting from the latent streaking (visible in the "green" variety of the domesticated canary) factor of the yellow canary, plus the color factor of the European goldfinch (Davenport, 1908, p. 20).

In 1914 the writer made several attempts to cross the domesticated canary with some of our native American finches, and some of the latter among themselves, since such crosses, if made, seem to have never been recorded. None of these experiments were successful. The work was again taken up in the fall of 1918, and this second attempt yielded several hybrids in 1919 and 1920. For these latter experiments the writer had at his disposal 22 wild finches belonging to the following species: Arkansas goldfinch (*Astragalinus psaltria hesperophilus* Oberholser), willow goldfinch (*Astragalinus tristis salicamans* [Grinnell]),<sup>3</sup> California linnet (*Carpodacus mexicanus frontalis* [Say]), and California purple finch (*Carpodacus purpureus californicus* Baird). Of these 22 wild finches, 5 were reared from eggs placed under

<sup>2</sup> Galloway (1909, p. 4), who has probably reared more canary-finch hybrids than any other breeder, reports the following proportions of self-colored to variegated (mottled) individuals in the case of canary-European gold-finch hybrids: (1) dark plumage (with no white or clear feathers), 172; (2) slightly variegated (a few small white or clear spots in an otherwise dark plumage), 74; (3) variegated (1/4 to 1/2 clear), 75; (4) lightly variegated (1/2 clear to small ticks of dark in an otherwise clear plumage), 19; and (5) completely clear (total absence of dark feathers), 0.

<sup>3</sup> A western sub-species of the American goldfinch (*Astragalinus tristis tristis* Linnæus), popularly known as the "wild canary."

canary females and the remaining 17 were trapped shortly before the breeding season. It is chiefly due to this second fact that the number of hybrids obtained was not larger. All of the experiments were carried out in separate breeding cages. The matings which yielded results were the following:

TABLE I

Cross No.	Year	♀	♂	No. of Offspring
1.....	1919	Yellow canary × California linnet		5
2.....	1920	Yellow canary <sup>4</sup> × Willow goldfinch		5
3.....	1920	Willow goldfinch × Arkansas goldfinch		4

The four hybrids resulting from cross No. 3 (willow goldfinch ♀ × Arkansas goldfinch ♂) died a few days after hatching, and the female could not be induced to breed for a second time. These hybrids differed from ordinary newly-hatched finches and from the eight hybrids obtained from crosses No. 1 and No. 2 in having exceedingly large abdomens, a condition which was probably due to the fact that a large quantity of yolk had not been assimilated.

Cross No. 1 (yellow canary ♀ × California linnet ♂) yielded three hybrids, one of which was accidentally killed when nine days old. During the same summer (1919) Mrs. L. V. Irelan of Berkeley, California, likewise succeeded in rearing a brood (2 males and 2 females) of canary-California linnet hybrids<sup>5</sup> which the writer was able to compare with his own.

Before going into detail regarding the coloration of these canary-California linnet hybrids, it seems desirable to refer briefly to the plumage color of the paternal species, the California linnet. Both sexes of this finch are grayish-brown in color, but, when about three months old, the male turns rose pink, orange red, or scarlet about

<sup>4</sup> The same female which was used in cross No. 1.

<sup>5</sup> In this case the mother was also completely yellow.

the head, neck, breast and rump. These colors increase in extent and brilliancy with each molt. Males reared and kept in captivity never develop anything but a yellowish-buff color in these regions, and if a mature wild male is confined, its red color, during the molt, likewise becomes yellowish-buff. Both adults and young are conspicuously streaked, especially the latter.

The six<sup>6</sup> canary-California linnet hybrids were all completely dark (self-colored) until the first molt (fall 1919), and closely resembled young California linnets, but their plumage was less intensely dark than that of the latter. During the fall molt of 1919 all of the hybrids became slightly "washed" (tinged) with yellow where the California linnet ♂ is red (or yellowish-buff). This yellow tinge was more conspicuous in the males than in the females and became somewhat more pronounced during the fall molt of 1920.

All six canary-California linnet hybrids are streaked, like the paternal and the "green" variety of the maternal species. As regards size and shape, they differ very little from the parents, both of which are similar in these respects. Their notes are intermediate in timbre between those of the two parental species, the males having a more powerful song than the canary.

In the spring of 1920 the writer paired two of these canary-California linnet hybrids. Both showed an ardent desire to breed and the female exhibited considerable skill in nest building. The first egg was laid on May 6, and several days later a second (May 10). Both of these eggs were only about half the size of canary or California linnet eggs<sup>7</sup> and were dark-blue in color, and not speckled, while those of both parental species are bluish-white and speckled. Both eggs were placed under canary females, but proved to be infertile. The male

<sup>6</sup> The hybrid which was accidentally killed was identical in coloration with these six.

<sup>7</sup> This corroborates similar observations by Bechstein (1795, IV, p. 469) and Blakston (1880?, p. 265), both of whom compare the eggs of canary-finch hybrids with peas.

used in this experiment was also mated with a yellow canary, but, despite much treading, all eggs were clear.

From cross No. 2 (yellow canary ♀ × willow goldfinch ♂) five<sup>8</sup> hybrids were obtained. A few years before, Dr. H. C. Bryant of the California Fish and Game Commission also succeeded in rearing a canary-willow goldfinch hybrid, concerning which he has been kind enough to furnish the writer with complete information.

Before considering the plumage color of these canary-willow goldfinch hybrids, it seems again desirable to sketch briefly that of the wild finch. Both young and adults of the willow goldfinch are chiefly olive-brown and black in color, but the sexually mature male turns canary-yellow during the summer, with the exception of the wings, tail and a small patch on the head, which remain black. Neither young nor adults show any streaking.<sup>9</sup>

The three canary-willow goldfinch hybrids reared by the writer are (January 6th, 1921) colored as follows: No. 1, completely dark (self-colored); No. 2, likewise, except for a few yellow feathers near the left eye; No. 3, dark, with a yellow band, about 5 mm. in width, running across the head; No. 4 (reared by Dr. Bryant),<sup>10</sup> dark, with some white feathers on the tail. All of the hybrids reared by the writer are conspicuously streaked, which, according to Dr. Bryant, was also true of hybrid No. 4.

As regards size and shape, the writer's canary-willow goldfinch hybrids closely resemble the canary (this was also true of hybrid No. 4), especially in shape of beak and length of tail, in which respects there is a considerable difference between the two parental species. As in

<sup>8</sup> Two of these died shortly after hatching and hence furnished no reliable data as regards coloration.

<sup>9</sup> This is also true of the remaining North American members of the genus *Astragalinus*, the Arkansas and the Lawrence goldfinch (*Astragalinus lawrencei* Cassin), except that in the case of the latter, the lower parts of the young are indistinctly streaked (cf. Bailey, 1912, pp. 322, 323).

<sup>10</sup> The canary mother of this hybrid was also completely yellow.

the case of cross No. 1 (yellow canary ♀ × California linnet ♂), the notes of the hybrids are intermediate in timbre between those of the parents.

We now come to the question as to how these hybrids compare with other canary-finch hybrids, and in how far they conform with Mendel's laws of inheritance. It will be noticed that in the case of the canary-California linnet hybrids, as in many mammalian crosses, dark color is completely dominant over light color, but the number of offspring (7) is too small to warrant the conclusion that this will always prove to be the case. On the other hand, as regards the canary-willow goldfinch hybrids, there is no complete dominance of one color, the hybrids in this case showing a similar variability to that of canary-European goldfinch hybrids.

Davenport (1908, p. 23) believes that the variability in plumage color of canary-finch hybrids is entirely due to the "mottling factor" of the yellow canary. He says (p. 23):

It [the yellow canary] carries a mottling factor. Consequently when the yellow canary is crossed with a pigmented canary or with a finch the hybrids are mottled.

In support of this hypothesis he makes the following statement:

That it is the yellow canary which contains the mottling factor and is the source of the variability of the hybrids is shown by the fact that (1) hybrids with the green canary do not vary in this fashion, and (2) hybrids between any two species of finches—of which many are bred by fanciers—are "cast in one mold."

As regards the first of these two points, it may be said that one should not expect canary-finch hybrids from a "green" (self-colored) canary to show yellow markings as frequently as when a yellow canary is used. In regard to the second point, Davenport (1908) seems to have overlooked the fact that Blakston (1880?), on whose authority this statement was probably based, states only (p. 274) that all bullfinch-goldfinch "mules" are "cast in one mould." In fact one of Blakston's (1880?) re-

marks clearly indicates that this is not true of the hybrids between all species of finches, for on the next page (275) he makes the following statement concerning the "much more common" greenfinch-goldfinch hybrid:

It is not a very pretty bird, . . . partaking to a considerable extent of its [the greenfinch's] dull colour, though occasionally a more brilliant example than usual, having a good deal of the Goldfinch character about it, appears on the stage.

Davenport's (1908) conclusion therefore does not seem to be very well founded.

Results published by Galloway (1909) since the appearance of Davenport's (1908) paper seem to throw some light on this question. As already stated, this author (Galloway) obtained 172 dark (self-colored) to 168 variegated (mottled) offspring from his canary-European goldfinch (*Carduelis carduelis*) crosses. However, when he used the siskin (*Carduelis spinus*), a closely related but darker species, he obtained nearly three times as many (36 to 13) self-colored as mottled individuals, that is, almost a 3 to 1, instead of a 1 to 1 ratio. These results, supported by those set forth in this paper, suggest that the frequency of mottling in canary-finch hybrids is not solely due to the yellow canary,<sup>11</sup> but probably also depends on the coloration of the wild finch.

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<sup>11</sup> A similar problem exists in regard to the mottled seed-coat of the  $F_1$  of certain pigmented-white bean crosses. Shull (1907) suggested that it is the white, and not the pigmented bean to which the mottling is due. However, Tschermak (1904, 1912) has shown that in some cases it is the pigmented bean which is the source of the mottling, a view which was later accepted by Shull (1908, pp. 437-439).



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